United States Patent

Ware

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[54] **FUEL SUPPLY SYSTEMS**

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[51] **Int. Cl.**.....**F02c 3/24**

[58] **Field of Search** .....60/39.74 R, 39.72 R, 39.65, 60/39.74 A; 431/328, 326; 239/145; 431/170

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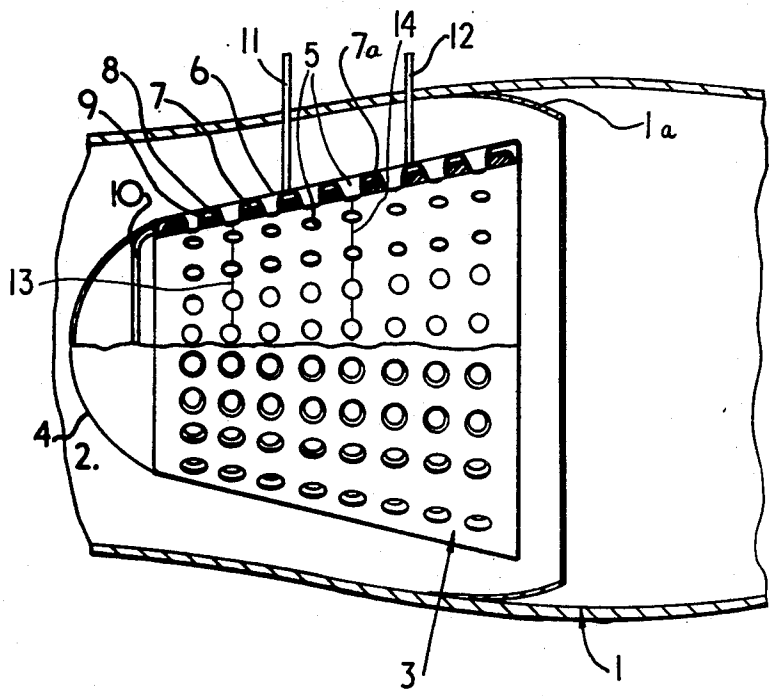
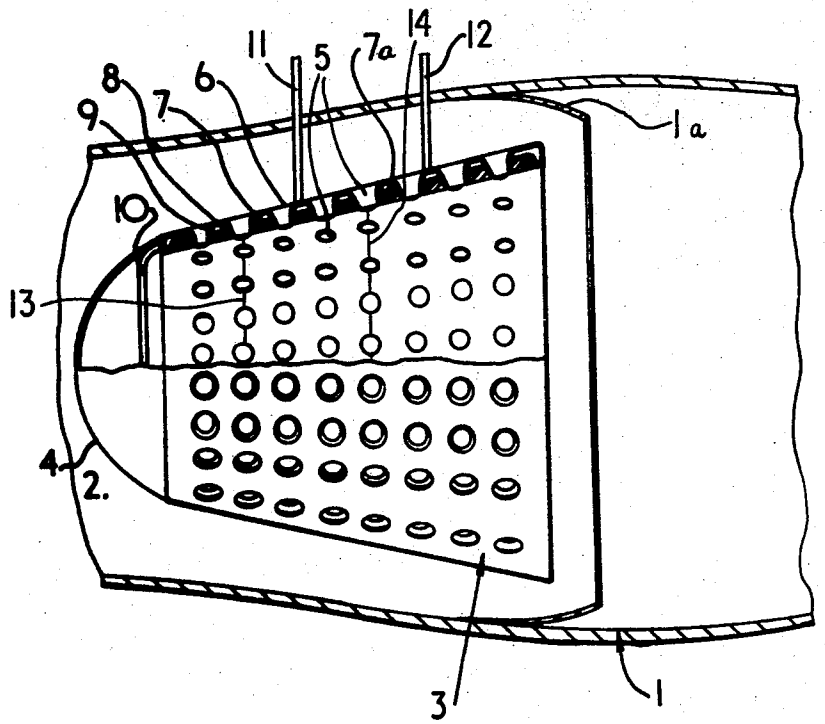
[57] **ABSTRACT**

A fuel supply nozzle for a gas turbine engine comprising a porous element pierced by a number of passages through which air may pass into the combustion chamber, drawing in fuel which is fed into the porous element.

7 Claims, 1 Drawing Figure

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FUEL SUPPLY SYSTEMS

This invention relates to fuel supply systems and particularly to systems for the supply of fuel to gas turbine engines.

One object of the invention is to provide an improved fuel supply nozzle for a gas turbine engine.

According to the invention a nozzle for supplying liquid or gaseous fuel to the combustion chamber of a gas turbine engine comprises an element formed from a porous material through which the fuel may flow, the element having a plurality of passages formed therethrough for the supply of air.

According to the invention also, a gas turbine engine incorporates a fuel supply nozzle comprising an element of porous material through which the fuel is arranged to flow, the element having a plurality of passages formed therethrough and arranged to be connected to a source of air pressure, the arrangement being such that a flow of air through the passages will carry the fuel into a combustion chamber.

The porous material may be a porous metallic material of the kind which is in the form of a three-dimensional network arranged to define a plurality of cellular spaces which intercommunicate with one another to form a continuous space phase. Material of this kind may be produced by spraying, dipping or electrodeposition of a metal on a polyurethane foam material. After deposition of the metal the polyurethane foam is removed by heating to "ash-out" the polyurethane. The polyurethane foam used is of the reticulated form, i.e. a foam in which the organic phase is a three-dimensional network with no substantial wall portions defining the cells, and the porous metallic material produced by the process outlined above has the property that it contains intercommunicating cells which have a capillary action and thus can act as a wick to conduct fluid through the material.

A particularly suitable material of the kind described above, having the characteristics of good durability at high temperatures, is the chromium alloy foam produced by the methods described in the specifications of copending U.S. Pat. application Ser. No. 847,428 and Ser. No. 50,383.

In a fuel supply nozzle in accordance with the invention the porous material described above may be in the form of a block or sheet having holes pierced therethrough to form air passages lined for at least part of their length with sheet metal, a backing plate being provided and sealed to the linings so as to enable air and fuel to be fed separately to the air passages and the porous material respectively. A number of examples of perforated structures of this kind are described in the copending U.S. Pat. application Ser. No. 53,104.

One embodiment of the invention will now be described, by way of example, with reference to the accompanying drawing, which is a diagrammatic cross-sectional side elevation of a gas turbine combustion chamber, showing a fuel supply nozzle, half in cross-section.

A combustion chamber **1** of a gas turbine engine is provided at the air inlet end **2** with a coaxially arranged fuel supply nozzle **3** of generally conical, hollow form having a closed and rounded leading end comprising a part-spherical cover member **4** formed from sheet-metal. The arrangement is such that combustion air

flows axially through the combustion chamber **1**, passing around the leading end **4** and the outside of the nozzle **3** and also radially inwardly through apertures **5** in the sides of the nozzle. Fuel is fed, through means to be described, to mix the air passing radially through the apertures **5** so as to burn in the combustion chamber, dilution air passing around the outside of the nozzle and being deflected into the combustion zone by a deflector **1***a*.

The body of the nozzle is formed from a sheet-metal outer skin **6** of hollow frusto-conical form which may be provided by spinning and which is fitted around a correspondingly shaped skin **7** of porous metallic material of the kind described above. The two skins are spaced from one another by means of dimples (not shown) formed in the outer sheet-metal skin **6** which form inwardly projecting areas to engage the inner skin **7**. The inwardly projecting areas on the outer skin may engage corresponding outwardly projecting areas on the inner skin to provide increased spacing. Conveniently, as illustrated, the skin **7** of porous metallic material may be strengthened by the provision of a metallic backing member **7***a* which is suitably pierced to enable liquid or gaseous fluid to penetrate the skin **7**.

Apertures **5** are formed by punching holes through the outer and inner skins **6** and **7** to constitute air supply passages sealed from the space between the two skins, which space constitutes a fuel supply gallery **8**. The sealing between the air supply passages **5** and the fuel supply gallery **8** is effected by punching the holes through the outer skin so as to deform the sheet-metal of the outer skin and carry it through to form linings **9** for the holes in the form of tubular projections. The seal may be improved by brazing. Fuel is supplied to the fuel supply gallery **8** through fuel feed pipes **10,11** and **12**.

In a turbine fuel supply nozzle of the kind described above arrangements can be made for suitable distribution points for the fuel to be provided so that a reduction in turbine power and heat output can be achieved by shutting off the supply to various zones of the nozzle. For example sheet metal segments **13** and **14** may be disposed between the apertures of two rings of apertures so as to divide axially the inner skin **7** and the gallery **8**, and thereby form a plurality of separate fuel supply zones served by the pipes **10**, **11** and **12** respectively. The zones furthest from the exit for hot gases, supplied through pipes **10** and **11** may be starved of fuel to produce an initial reduction in power, and progressive shutting down of fuel supplies may follow, leaving finally only a small continuously burning ring near the exit.

A fuel supply nozzle as described above has an important advantage in that it is suitable for use with a wide range of fuels, both liquid and gaseous.

Having now described my invention, what I claim is:

1. A nozzle for supplying liquid or gaseous fuel to the combustion chamber of a gas turbine engine, comprising, an element formed from a sheet of porous material having small pores through which fuel may flow, said element additionally having a surface area substantially throughout which a plurality of passages are distributed, said passages being substantially larger than said small pores, and said passages extending through said element in a direction substantially perpendicular

to the surface of said element for supplying air through said element, and a backing member superimposed on said element in a spaced relationship from said element to form a fuel supply gallery between said backing member and said element, said backing member formed with a plurality of apertures therein corresponding to the plurality of passages in said element, the backing member material surrounding each aperture formed as a tubular projection extending into association with its corresponding passage in the element.

2. A nozzle according to claim 1, in which the porous material is metallic material of the kind in the form of a three-dimensional network arranged to define a plurality of cellular spaces which intercommunicate with one another to form a continuous space phase.

3. A nozzle according to claim 1 which is of a hollow conical form having the fuel supply gallery arranged external to the porous material.

4. A nozzle according to claim 3 in which the leading end of the nozzle is provided with a rounded cover member.

5. A nozzle according to claim 1, said nozzle having a plurality of zones, each of said zones having an independent fuel supply means.

6. A gas turbine engine incorporating a nozzle according to claim 1.

7. A nozzle according to claim 1, wherein said tubular projections extend into the corresponding passages of said element, in contact with said element.

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